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- ²Power and antenna height are restricted to the minimum necessary to achieve the required service.
³Transmitter power may be increased to overcome line and duplexer losses but must not exceed 25 watts delivered to the antenna.
⁴Frequency, emission, and maximum power will be determined after coordination with appropriate Government agencies.
⁵To be used with airborne marine equipment certificated for part 80 (ship) and used in accordance with part 87.
⁶Applicable only to marine frequencies used for public correspondence.
⁷Frequency, emission, and maximum power will be determined by appropriate standards during the certification process.
⁸Power may not exceed 60 watts per carrier. The maximum EIRP may not exceed 2000 watts per carrier.
⁹Excludes automatic link establishment.
¹⁰Power is limited to 0.5 watt, but may not exceed 2 watts when station is used in an automatic unattended mode.

[54 FR 11720, Mar. 22, 1989, as amended at 57 FR 45749, Oct. 5, 1992; 62 FR 40308, July 28, 1997; 63 FR 36607, July 7, 1998; 64 FR 27474, May 20, 1999; 66 FR 26798, May 15, 2001]

§ 87.133 Frequency stability.

(a) Except as provided in paragraphs (c), (d), and (f) of this section, the carrier frequency of each station must be maintained within these tolerances:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance ¹	Tolerance ²
(1) Band-9 to 535 kHz:		
Aeronautical stations	100	100
Aircraft stations	200	100
Survival craft stations on 500 kHz	5,000	20 Hz ³
Radionavigation stations	100	100
(2) Band-1605 to 4000 kHz:		
Aeronautical fixed stations:		
Power 200 W or less	100	100 ⁸
Power above 200 W	50	50 ⁸
Aeronautical stations:		
Power 200 W or less	100 ⁷	100 ^{7,8}
Power above 200 W	50 ⁷	50 ^{7,8}
Aircraft stations	100 ⁷	100 ⁷
Survival craft stations on 2182 kHz	200	20 Hz ³
(3) Band-4 to 29.7 MHz:		
Aeronautical fixed stations:		
Power 500 W or less	50	
Power above 500 W	15	
Single-sideband and Independent-sideband emission:		
Power 500 W or less		50 Hz
Power above 500 W		20 Hz
Class F1B emissions		10 Hz
Other classes of emission:		
Power 500 W or less		20
Power above 500 W		10
Aeronautical stations:		
Power 500 W or less	7 100	100 ⁷
Power above 500 W	7 50	50 ⁷
Aircraft stations	7 100	100 ⁷
Survival craft stations on 8364 kHz	200	50 Hz ³
(4) Band-29.7 to 100 MHz:		
Aeronautical fixed stations:		
Power 200 W or less	50	
Power above 200 W	30	
Power 50 W or less		30
Power above 50 W		20
Operational fixed stations:		
73–74.6 MHz (Power 50 W or less)	50	30
73–74.6 MHz (Power above 50 W)	20	20
72–73.0 MHz and 75.4–76.0 MHz	5	5
Radionavigation stations	100	50
(5) Band-108 to 137 MHz:		
Aeronautical stations	4 50	12 20
Emergency locator transmitter test stations	50	50
Survival craft stations on 121.5 MHz	50	50

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance ¹	Tolerance ²
Emergency locator stations	50	50
Aircraft and other mobile stations in the Aviation Services	5 50	13 30
Radionavigation stations	20	20
Differential GPS		2
(6) Band-137 to 470 MHz:		
Aeronautical stations	50	20
Survival craft stations on 243 MHz	50	50
Aircraft stations	50 ⁵	30 ¹⁰
Radionavigation stations	50	50
Emergency locator transmitters on 406 MHz	N/A	5
(7) Band-470 to 2450 MHz:		
Aeronautical stations	100	20
Aircraft stations	100	20
Aircraft earth station		320 Hz ¹¹
Radionavigation stations:		
470–960 MHz	500	500
960–1215 MHz	20	20
1215–2450 MHz	500	500
(8) Band-2450 to 10500 MHz:		
Radionavigation stations	6, 9 1250	1250 ^{6, 9}
(9) Band-10.5 GHz to 40 GHz:		
Radionavigation stations	5000	5000

¹This tolerance is the maximum permitted until January 1, 1990, for transmitters installed before January 2, 1985, and used at the same installation. Tolerance is indicated in parts in 10⁶ unless shown as Hertz (Hz).

²This tolerance is the maximum permitted after January 1, 1985 for new and replacement transmitters and to all transmitters after January 1, 1990. Tolerance is indicated in parts in 10⁶ unless shown as Hertz (Hz).

³For transmitters first approved after November 30, 1977.

⁴The tolerance for transmitters approved between January 1, 1966, and January 1, 1974, is 30 parts in 10⁶. The tolerance for transmitters approved after January 1, 1974, and stations using offset carrier techniques is 20 parts in 10⁶.

⁵The tolerance for transmitters approved after January 1, 1974, is 30 parts in 10⁶.

⁶In the 5000 to 5250 MHz band, the FAA requires a tolerance of ±10 kHz for Microwave Landing System stations which are to be a part of the National Airspace System (FAR 171).

⁷For single-sideband transmitters operating in the frequency bands 1605–4000 kHz and 4–29.7 MHz which are allocated exclusively to the Aeronautical Mobile (R) Service, the tolerance is: Aeronautical stations, 10 Hz; aircraft stations, 20 Hz.

⁸For single-sideband radiotelephone transmitters the tolerance is: In the bands 1605–4000 kHz and 4–29.7 MHz for peak envelope powers of 200 W or less and 500 W or less, respectively, 50 Hz; in the bands 1605–4000 kHz and 4–29.7 MHz for peak envelope powers above 200 W and 500 W, respectively, 20 Hz.

⁹Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations must be maintained within the band allocated to the service and the indicated tolerance does not apply.

¹⁰Until January 1, 1997, the maximum frequency tolerance for transmitters with 50 kHz channel spacing installed before January 2, 1985, is 50 parts in 10⁶.

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¹¹ For purposes of certification, a tolerance of 160 Hz applies to the reference oscillator of the AES transmitter. This is a bench test.

¹² For emissions G1D and G7D, the tolerance is 2 parts per 10⁶.

¹³ For emissions G1D and G7D, the tolerance is 5 parts per 10⁶.

(b) The power shown in paragraph (a) of this section is the peak envelope power for single-sideband transmitters and the mean power for all other transmitters.

(c) For single-sideband transmitters, the tolerance is:

- (1) All aeronautical stations on land other than Civil Air Patrol.....10 Hz
- (2) All aircraft stations other than Civil Air Patrol.....20 Hz
- (3) Civil Air Patrol Stations50 Hz

(d) For radar transmitters, except non-pulse signal radio altimeters, the frequency at which maximum emission occurs must be within the authorized frequency band and must not be closer than 1.5/T MHz to the upper and lower limits of the authorized bandwidth, where T is the pulse duration in microseconds.

(e) The Commission may authorize tolerances other than those specified in this section upon a satisfactory showing of need.

(f) The carrier frequency tolerance of transmitters operating in the 1435–1535 MHz and 2310–2390 MHz bands manufactured before January 2, 1985, is 0.003 percent. The carrier frequency tolerance of transmitters operating in the

1435–1535 MHz and 2310–2390 MHz bands manufactured after January 1, 1985, is 0.002 percent. After January 1, 1990, the carrier frequency tolerance of all transmitters operating in the 1435–1535 MHz and 2310–2390 MHz bands is 0.002 percent.

[53 FR 28940, Aug. 1, 1988, as amended at 56 FR 38084, Aug. 12, 1991; 57 FR 45749, Oct. 5, 1992; 58 FR 31027, May 26, 1993; 63 FR 36607, July 7, 1998; 64 FR 27474, May 20, 1999; 66 FR 26799, May 15, 2001]

§ 87.135 Bandwidth of emission.

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

§ 87.137 Types of emission.

(a) The assignable emissions, corresponding emission designators and authorized bandwidths are as follows:

Class of emission	Emission designator	Authorized bandwidth (kilohertz)		
		Below 50 MHz	Above 50 MHz	Frequency deviation
A1A ¹	100HA1A	0.25		
A1N	300HA1N		0.75	
A2A	2K04A2A	2.74	50	
A2D	6K0A2D		50	
A2D ⁵	13K0A2D		50	
A3E ²	6K00A3E		³ 50	
A3E	3K20A3E ¹⁵		¹⁵ 25	
A3X ⁴	3K20A3X		25	
A9W ⁵	13K0A9W		25	
F1B ¹	1K70F1B	1.7		
F1B ¹	2K40F1B	2.5		
F2D	5M0F2D		(⁹)	
F3E ⁶	16K0F3E		20	5
F3E ⁷	36K0F3E		40	15
F7D ⁸	5M0F7D		(⁹)	
F9D	5M0F9D		(⁹)	
G1D	16K0G1D		20kHz	
G1D ¹⁶	21K0G1D		25	
G1D	14K0G1D	25
G1E ¹⁶	21K0G1E		25	
G1W ¹⁶	21K0G1W		25	